



Earthquake Hazards

The Modified Mercalli Intensity Scale

Status -
Completed

The effect of an [earthquake](#) on the Earth's surface is called the [intensity](#). The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally - total destruction. Although numerous *intensity scales* have been developed over the last several hundred years to evaluate the effects of [earthquakes](#), the one currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale, composed of increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects.

The Modified Mercalli Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the [magnitude](#) because intensity refers to the effects actually experienced at that place.

The **lower** numbers of the intensity scale generally deal with the manner in which the earthquake is felt by people. The **higher** numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above.

Contacts

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Intensity	Shaking	Description/Damage
I	Not felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Abbreviated description of the levels of Modified Mercalli intensity. (Public domain.)

Abridged from [The Severity of an Earthquake](#), USGS General Interest Publication 1989-288-913

History and Details of MMI

The following is an excerpt from [Intensity Distribution and Isoseismal Maps for the Northridge, California, Earthquake of January 17, 1994](#).

The intensity of an earthquake at a location is a number that characterizes the severity of ground shaking at that location by considering the effects of the shaking on people, on manmade structures, and on the landscape.

Intensities assigned by the U. S. Geological Survey and (prior to 1973) by agencies in the U. S. Department of Commerce have for many decades been based on the [Modified Mercalli Intensity Scale](#) of 1931 (Wood and Neumann, 1931), which we usually refer to simply as the "Modified Mercalli" or "MM" scale. The scale lists criteria that permit the seismologist to represent the severity of ground shaking in a community or part of a community by a number. Experience with the MM scale in the decades since 1931 has shown that some criteria are more reliable than others as indicators of the level of ground shaking. Moreover, construction methods have changed appreciably since the scale was introduced. Assigning of MM intensity values therefore involves use of the original criteria of Wood and Neumann (1931) with amendments and modifications that have been developed in the decades since 1931.

...

The Modified Mercalli scale is given as originally abridged by Wood and Neumann (1931) ... the unabridged scale is reproduced in Stover and Coffman (1993). ... Since 1931 it has become clear that many phenomena that Wood and Neumann (1931) originally used as criteria to define the highest Modified Mercalli intensities (X and above) are related less to the level of ground shaking than to the presence of ground conditions susceptible to spectacular failure or to the ease with which seismic faulting of different style and depth can propagate to the ground surface. Criteria based on such phenomena are downweighted now in assigning of USGS intensities (Stover and Coffman, 1993).

References

- Dewey, James, B. Glen Reagor, L. Dengler, K. Moley (1995). Intensity Distribution and Isoseismal Maps for the Northridge, California, Earthquake of January 17, 1994, USGS Open-File Report 95-92.
- Stover, C. W., and Coffman, J. L. (1993). [Seismicity](#) of the United States, 1568-1989 (Revised): U. S. Geological Survey Professional Paper 1527, 418 p.
- Wood, H. O., and Neumann, Frank (1931). Modified Mercalli Intensity Scale of 1931: Seismological Society of America Bulletin, v. 21, no. 4, p. 277-283.